

## **Accelerator Systems Division Highlights Ending January 7, 2005**

### **ASD/JLAB: Cold Linac**

Assembly of the H-10 and H-11 cryomodules is complete. H-10 will be shipped to ORNL next week.

### **ASD/BNL: Ring**

On December 20<sup>th</sup>, a soft ride truck was sent to SNS/OR. It contained RF #4 and stand; PA and rack; anode PS;

BLM Ion Chambers; BLM / VME chassis and a VME crate for HEBT vacuum.

Injection quadrupole doublet #2 was shipped from BNL on Tuesday, January 4.

RF quadrupole doublet #1 will be shipped on January 11.

Final assembly and testing of RF quad doublet #2 is underway. Delivery is scheduled for January 25.

Being prepared for shipment on January 18: injection kicker magnet (short) and stand; wall current monitor (RF); RF power supply; vacuum chambers - 3 Ring and 10 RTBT; PLC for HEBT vacuum controller; balance of BLMs (4 boxes ~ 220 units); LANL motion chassis and cables (one box).

Data coordinates for survey / installation of the injection straight section were sent to ASD. Data file "INJ\_AREA\_DGN.DAT" is a comprehensive file that combines all of the magnets, magnet stands, vacuum pipe locations (as built), chain saw, electron collector, foil centerline, both injection septums, and both dump septums.

At the request of ASD, the BNL/SNS Vacuum Group is working on a cost estimate to provide two (2) TiN coated dummy drift pipes for the two Ring IPMs. The estimate is being made on the assumption that the existing IPM bellows can be reused.

Work has commenced on the Video Foil work package that had been put on hold pending funding resources within the BNL/SNS Diagnostics' budget. Based on actuals through December 2004, Tom Russo has been given the green light to re-start these efforts.

Mike Hemmer's document "SNS/BNL Lattice Device Inventory" has been scanned into our eng-arch on the BNL drawing server. It has an SNS document number and will be converted into a BNL Tech Note after final revisions are made.

### **Controls**

The current plans for the CLO Control Room (CCR) were confirmed at a meeting of all stakeholders this week. Some consoles will have three, rather than six screens – all consoles will be modularized allowing either configuration. The possibility of moving the entire circle of consoles two feet to the south will be sketched and considered. A prototype console will be delivered by DCS next week. Assuming minimal design changes are required, the complete north arc (7 consoles) should be available for use by the end of February. Two prototype OPIs have been ordered for the new Control Room.

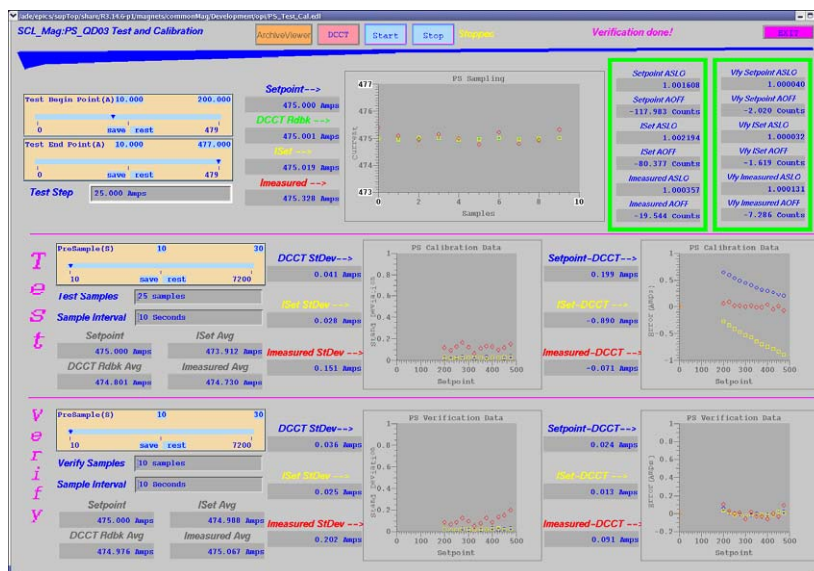
In a collaboration with the power supply group, the power supply SCL\_Mag:PS\_QD03 was tested by our EPICS based test software. Linearity tests took about two hours. The screen shot below shows setpoint and readback errors for an uncalibrated supply in the +/- 1 amp range. The calibrated plot (bottom right) shows errors in the +/- 0.1 amp range. A plan for collaborative testing of the remaining SCL warm section power supplies was agreed. The HEBT power supply test is ready from control's view point – both software and hardware are installed and tested.

The vacuum system for MB 9-11 is ready to run RF. The next vacuum system (HB 1-4) is ready for testing. All equipment and wire is installed. The data base will be loaded on the IOC and check out will begin early next week.

The first test with a Cryo module open to a warm section took place this week. The warm section control valves were operated from the control system for the first time.

In an attempt to address persistent problems of communications drop-out, a new VxWorks kernel and EPICS Version (3.14.7) were deployed in two DTL/CCL RCCS IOC's for testing. Early results are promising. To achieve this, the MPS databases were rebuilt and verified under v3.14.7.

The MEBT LLRF IOC's were updated to be the same as all others. This is a notable milestone which will greatly facilitate operational support. Some investigation took place of how best to determine the "delay" value for the adaptive feed forward: We can find one that works with trial and error, but we don't know how to determine the ultimate one. Maybe that's because its value is not critical?



The new Beckhoff driver has been working without failure in two HPRF IOC's for two weeks. It is ready for more widespread deployment, and it will be deployed for the MEBT chopper controller. A single mini-pulse feature was added to the LEBT Chopper prototype. Design techniques are being developed to be applied to the planned "next-generation" LEBT chopper controller.

The Controls Group continues to use 10-12 electricians. An SRO was submitted for installation of communications to Klystron Building rack rows 40 and 41. Work continues on finalizing the Ring Service Building (RSB) communications cabling design and timing system block diagrams were updated to support RSB cable design.

The fault hardware on the Ion Source 65Kv controller was replaced this week.

A "controllability" measurement was conducted on the RCCS 3-way control valve. Resolution was 1.4% or 0.24 ma when ramping up the valve and 1.3% or 0.21 ma when ramping down. The dead band is from 1.3% moving in direction to 3% moving in changing direction. This data will be used in the valve PID control algorithm.

The SCL HB 1-4 EPICS database is now on line, checked out and ready for next week's field device functional checkout for Zone 4 (1st section of HB SCL vacuum system)

The Application Development Environment (ADE) for PLC application software development and versioning release control procedure is established for the vacuum and RCCS subsystems. The documentation is under its way for other subsystem PLC engineers' reference.

Some training was provided to Operations in the use of CVS, and an operations area has been provided in the ADE for screen development by Operations.

## Installation

Craft Snapshot 1/4/05

|                               |             |
|-------------------------------|-------------|
| ASD productive craft workers  | <b>72.0</b> |
| Foremen (Pd by 15% OH)        | 6.0         |
| AMSI management (Pd directly) | 3.0         |
| TOTAL AMSI WORKERS            | 81.0        |
| Less WBS 1.9, 1.2 etc         | <b>8.0</b>  |
| Less absent                   | <b>3.0</b>  |
| TOTAL PD BY ASD/ORNL DB WPs   | <b>61.0</b> |

## Accelerator Physics

Further measurement and analysis of MEBT beam profiles show input Twiss parameters consistent with earlier measurements. These confirm previous observations of a large RFQ output Twiss error in the vertical plane.

Comparison of DTL/CCL beam profiles with model predictions is very good up to the DTL/CCL transition region. In order to obtain good agreement in the CCL, matching quads have to be adjusted in the model by as much as 7%. Analysis continues on this issue.

A study is in progress to determine DTL RF setpoints based on multiparticle simulation results. D. Jeon shows good agreement between measured and simulated BPM phase scans. This method may provide more refined RF setpoints for earlier DTL tanks.

Y. Zhang is analyzing the beam limits from thermal stress in the copper beamstop in the CCL/SCL transition region. Preliminary results show that the beamstop can handle 52mA ("old" design current) 40 microsecond pulse. Analysis continues at varying beam energies.

The Ring online-model in XAL is working. It produces beta-functions and closed-orbits that agree with MAD. The CCL Delta-T algorithm has been written within the XAL framework. The XAL delta-T program will replace the LabVIEW program used during CCL commissioning.

Simulations show that beam can be circulated around the ring without using the injection kickers, by inserting horizontal and vertical closed orbit bumps in the vicinity of the stripper foil using the dipole corrector magnets. This will likely be the mode of operation the first time beam is injected into the ring since it will simplify the setup.

Simulations are also in progress using as-measured magnetic multipole strengths to check for any adverse effects of the multipole components in the ring. Initial results look promising, with no adverse effects identified so far.

## Operations

Running Beam Operation for Ion Source studies

Beam runs until January 17, 2005

Running shifts in support of:

Operability Run

Beam Operations

DTL 5 Investigations

SCL Processing

Planning for the PPS recertification for new equipment next Wednesday.

Revised the Timeline for Commissioning of HEBT-Ring-RTBT to X-Dump and RTBT to Target commissioning

Working on the Transition to Operations plan and training/integrating the XFD Operators.

Working on the Maintenance Management System

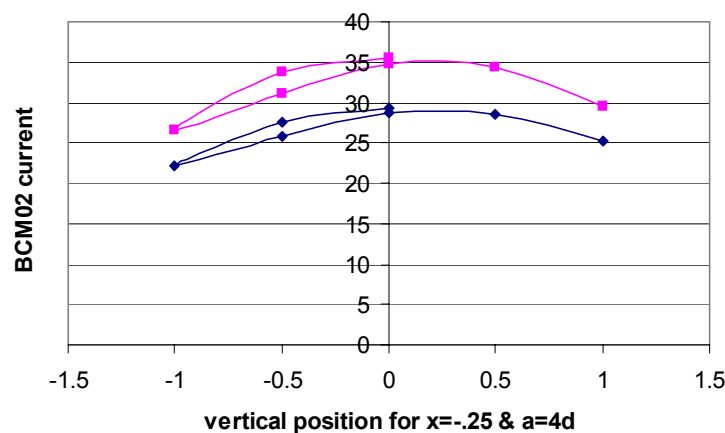
Preparing to submit DTL-CCL Power Supply data this week.  
Meet with Peter Ladd on DTL-CCL Vacuum data

Revised the approach for radiation area postings

Met with ORNL SBMS group on the regulations for planning work in radiation areas

## Ion Source

Horizontal MEBT emittances and BCM02 currents have been measured for about 50 ion source positions and tilt angles. The recently installed tilt indicator and flexible antenna connections allow for adjusting the tilt angle between  $0^\circ$  and  $5.4^\circ$  with an accuracy of about  $0.1^\circ$  while the source is delivering beam. The accuracy of the ion source and LEBT position is a challenge due to the 10,000 lbs of air pushing the LEBT chamber against the flange on which the LEBT and ion source are mounted. Despite, position cranks delivered with the FE from LBNL allow for a relatively smooth movement with respect to the RFQ. The position indicators that were recently installed next to the position cranks, allow for controlling the local position of the LEBT flange to an accuracy of  $\sim 0.01$  mm. However beam current measurements indicate that it takes several minutes until the LEBT center comes to rest in the new position, most likely due to relaxation of the LEBT ring flange distorted by the force from the crank. The same process is likely the cause for the hysteresis of the transmission when moving the source as observed in the figure below. This tends to limit the accuracy of the actual LEBT and ion source position to about 0.1 to 0.2 mm.



The transmission of the beam current peaks around 3-4 degrees with  $x$  close to the previously tuned position at  $x=0$ . As expected, the measurements show a negative correlation between position and angle. The emittance measurements suggest a minimum near 4 degrees and -0.5 mm, where the transmission is still at its maximum.

## Survey and Alignment

S&A recorded “as-built” measurements of the transfer line stab off tubes for the U-tubes along with the stab of tubes for the U-tubes on Cryomodules MB08 thru HB 03. This “as-built” will help the Cryo Group to prefabricate the U-tubes.

S&A also aligned cryo-module number 7.

Three 8Q35 magnets located in magnet measurement area of the CLO were fiducialized.

S&A also rough aligned the two 8Q35 magnets on a warm section raft located in magnet measurement in the CLO.

We final aligned the two 8Q35's along with the beam pipe on one warm section located in the ring. It will be final aligned to ideal position once moved from the ring to the Linac. Our records for work performed on warm sections are as follows:

- 40 8Q35 Magnets fiducialized, 28 remaining

- 3 Warm sections aligned in position
- 1 Warm section being aligned in position today.

Two additional half cell assemblies were aligned in “D” arc.

S&A is continuing to update and modify drawings and data bases for eventual transfer in to ProjectWise.

Settlement deformation data recorded from December 2004 indicate that some minor yet diminishing settlement is still occurring. As of 09 December, 2004, maximum settlement at the RTBT/ Target Interface was 7.101 inches. For a more in depth report please contact S&A.

S&A laid out the concrete form work location points for instrument line # 3.

With no known data on the core vessel flanges, except for a statement from the vendor stating machining is within specs, there are concerns of adjacent instrument lines interfering with each other. A request has been made to lay out the bisector lines between each instrument line. S&A has laid out the bisector between instrument beam lines three and four along with as-building the poured in place concrete of beam line #2.

During a routine bolt layout survey, some anomalous results were found in the region of two large floor cracks in the ring, between A arc and B arc. A small, high-precision re-observation survey was performed to check the control network integrity in that area. Preliminary analysis of the results shows that the two portions of the floor separated by the cracks are moving independently of each other. The magnitude of the deformation appears to be in the range of 0.3 to 0.4 mm (over the last 7 months), and is expressed in the Y and X directions. Further analysis of the data is underway to better define the deformation.

In an attempt to predict future settlement rates for the three beam dumps, the elevation history of the dumps is being compared with the elevation history of the floor monuments in nearby portions of the tunnel system. When monuments with similar patterns of settlement are identified, curve fitting is performed with the (more frequent) elevation history of the floor monuments to predict the dump settlement.

## **Mechanical**

We are continuing to diagnose the problem of DTL5 not being able to operate at increased average power levels. Some interesting results were received from a test to measure X-ray emission from the cavity. We are simultaneously pursuing several angles on this issue.

All physics and diagnostics testing on the warm linac are being completed ahead of a January 16th shutdown during which the integration of the warm and cold linacs will be accomplished.

## **Water Systems Installation**

- Installation of the HEBT tunnel magnet cooling completed to first 9 magnets.
- Installation of the RING SB power supply cooling system manifolds continued.
- Installation of the RING SB power supply cooling system pump upgrade completed.
- Installation of the RING SB power supply cooling system make-up water supply completed.
- Installation of the SCL Cryo Warm Section Magnet cooling connections continued.
- Installation of the SCL ME05 HVCM and SCR cooling system completed.
- Installation of the SCL ME06 HVCM and SCR cooling system started.
- Maintenance activities included cleaning of the LINAC RCCS filters.

## **Ring Systems Installation**

- The Ring Injection straight section downstream Doublet Magnet assy was received and staged for installation.
- The Ring RF Cavity #4 was received and staged for Installation.
- The Ring arc heavy cable installation continued.
- The RTBT Collimators #1 & 2 were set in position.

- The RTBT 21Q40 magnet stands continue to be set in position.

### **Magnet Task**

This week we moved MB06 and MB07 warm sections out so that MB07 Cryomodule could be moved out. A new Cryomodule was installed and today we re-installed MB06 and MB07. We also installed MB10 warm section. MB11 is being aligned. So, Warm Sections are in place from MB03 through MB10. We have also mapped more 8Q35's. There are about 20 or so 8Q35's left to map. We have three magnet assemblies ready to accept beam tubes.

The measurement coil frame for the RTBT Dipole arrived and is being assembled and checked out.

### **Electrical Group**

Electrical Installation:

- Tunnel - Completed wiring for SCL module HB4 in tunnel, performing terminations for SCL module HB5.
- SCL ME5 area – large cabling complete, pulling diagnostic and vacuum cables. Overall, 70% complete
- SCL ME6 area – heavy cable pulls and ac wiring underway.
- SCL ME8 area – magnet cabling 75% complete, racks installed
- HEBT – all wiring complete except for magnet in entry way (not installed yet).
- Ring – AC power terminations continuing for RF systems, PPS wiring.
- CLO – control room installation continues.

Power Supplies:

- Completed power supply/magnet integrated tests for Linac SCL warm sections MB-3 and MB-4.
- Started installation of power supplies in SCL ME6 and ME8 area.
- Completed installation of all Ring Injector Kicker Supplies.

DTL-ME3 experienced a SCR failure on Wednesday evening. We were able to fix it in 4 hours, but are getting low on spare parts again. I have communicated with the vendor regarding our recent poor SCR reliability and continue to work on the new SCR firing card. We expect to begin testing that card after MLK Day in CCL-ME4. SCL-ME5 installation is complete, and we expect to begin testing next week. SCL-ME6 installation is underway, with the SCR cabinet and safety enclosure set. Testing of an improved anti-saturation IGBT gate drive circuit will begin next week under full current switching conditions.

### **HPRF**

Ring RF

- Working on updating the device name list.
- Working on completing wire lists for DC cables. We will have the electrical team terminate the DC cables.
- Have materials on order to complete AC Power installation.

### **LLRF**

Installation: Installation continues on SCL ME-4 and ME-5.

Operations and Testing Support: In addition to our usual operations support, we are working shifts to support SCL cryomodule testing.

Upgrades: The normal-conducting linac LLRF systems were recently upgraded to the latest firmware and software, which includes improved HPM operation, separate timing on dual systems (MEBT), and system performance measurement tools on the FCM.

## **Cryo Group**

Utube fabrication is complete

Dummy Cryomodule is complete

Supporting 24/7 cryogenic operation

Working on the warm section pipe cleaning

Working on the Cryo Module preparation in the tunnel

JLab production:

- Cryomodule H10 will arrive at ORNL January 12
- H11 is on the rails with end cans being cold-shocked
- H12 tuners are being assemble on the string
- H2 string is in the clean room

Cryomodule testing

- Nightly operation of the available cryomodules is continuing to determine operability of the systems.
- Pulse length have been increased on selected cavities to over 1 ms
- The permission has been obtained to increase the incident power radiological limit to 250 kW
- Preparation for the gate valve opening test to qualify warm sections is under way. Field emission thresholds for two of the cavities involved have been determined and equipment necessary for the test has been verified to work

## **Beam Diagnostics**

Work on Updating NAD OS to XP embedded SP2: Testing to resolve module interdependencies showed several new modules needed to be added

Setup of Ch0 .Accelerator Installation message system to notify workers about work in progress. The system is a Network Attached Device that handles the messages using EPICS. The messages can be entered through the operators EDM screen. The clients can display the messages as well as the accelerator status, similar to Ch13. Display Clients have been placed at the HEBT service building and the front-end building. See attached pictures.

Design of CLO lab space: Another revised layout for our CO space has been made.

NAD for longitudinal laser profile to take data this last week of  
beam: NAD hardware put together and NAD software created, analysis software in progress.

SCL laser: 6 out of 8 transfer line boxes are installed, beambox 3&4 installed, 3 is tested & passed

HEBT: cabling for wirescanner, BCM, BLM, and FBLM is dressed in racks

PCI timing card: Preproduction boards came in and are being stuffed